FM 6-40
MCWP 3-16.4

Tactics, Techniques, and Procedures for the Field Artillery Manual Cannon Gunnery

U.S. Marine Corps

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FOREWARD

This publication may be used by the US Army and US Marine Corps forces during training, exercises, and contingency operations.

General, USA
Commanding
Training and Doctrine Command

Lieutenant General, USMC
Commanding General
Marine Corps Combat Development Command

PREFACE

This field manual (FM) explains all aspects of the cannon gunnery problem and presents a practical application of the science of ballistics. It includes step-by-step instructions for manually solving the gunnery problem and applies to units organized under tables of organization and equipment (TOE) of the L series. The material concerns nonnuclear solutions to the gunnery problem. Automated procedures are covered in ST 6-40-2, ST 6-40-31, and ST 6-50-60.

This publication is a guide for field artillery (FA) officers (commanders and fire direction officers [FDOs]), FA noncommissioned officers (NCOs), and enlisted personnel in the military occupational specialty (MOS) of cannon gunnery (MOS 13E; United States Marine Corps [USMC] MOS 0844/48).

This publication implements the following North Atlantic Treaty Organization (NATO) Standardization Agreements (STANAGs)/Quadripartite Standardization Agreements (QSTAGs):

STANAG	QSTAG	TITE
2934 (Chap 10) (Ed 1)	182 (Ed 2)	Artillery Procedures, Battlefield Illumination
2934 (Chap 6) (Ed 1)	255 (Ed 3)	Artillery Procedures, Call for Fire Procedures
2934 (Chap 7) (Ed 1)	221 (Ed 2)	Artillery Procedures, Target Numbering System (Nonnuclear)
2934 (Chap 5) (Ed 1)	246 (Ed 3)	Artillery Procedures, Radio Telephone Procedures for the Conduct of Artillery Fire
2934 (Chap 3) (Ed 1)	217 (Ed 2)	Artillery Procedures, Tactical Tasks and Responsibilities for Control of Artillery
2963 (Ed 1)	802 (Ed 1)	Coordination of Field Artillery Delivered Scatterable Mines
4119 (Ed 1)	220 (Ed 2)	Adoption of a Standard (Cannon) Artillery Firing Table Format
none	224 (Ed 2)	Manual Fire Direction Equipment, Target Classification, and Methods of Engagement for Post-1970
4425 (Ed 1)	none	Procedure to Determine the Degree of Interchangeability of NATO Indirect Fire Ammunition-APO-29

The proponent of this publication is Headquarters (I-IQ), US Army Training and Doctrine Command (TRADOC). Send comments and recommendations on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to Commandant, US Army Field Artillery School (USAFAS), ATTN: ATSF-GD, Fort Sill, OK 73503-5600.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

13-42. Sense And Destroy Armor (SADARM M898)

The M898 SADARM projectile is a base ejecting munition carrying a payload of two target sensing submunitions. The projectile is a member of the DPICM family, and is ballistically similar to the M483A1. The technical fire direction computations are similar to those used for the ADAM projectile, in that low level wind corrections must be applied to the firing solution (because of the high Height of Burst) in order to place the payload at the optimal location over the target area.

13-43. M898 Firing Data Computations

Firing data are computed for SADARM by using the FT 155 ADD-W-0 or FT 155 ADD-W-1 in conjunction with the FT 155 AN-2. The difference between the ADD-W-0 and ADD-W-1 is the Height of Burst of the projectile. The ADD-W-1 increases the HOB to correct for changes in the operational parameters of the projectile. The ADD-W-1 is the preferred method of producing data, although the ADD-W-0 procedure may be used in lieu of the FT ADD 155-W-1 if it is unavailable. (Note: BCS Version 11 will incorporate the ADD-W-1 solution. BCS Version 10 has the incorrect HOB, and automated firings must also incorporate the change in HOB discussed in the ADD-W-0 method).

13-44. Technical Fire Direction Procedures

Technical fire direction procedures consist of four steps (following the Fire Order):

a. Determine chart data to the target location. Chart range, chart deflection, and angle "T" are recorded on the DA-4504 (Record of Fire) in the Initial Fire Commands portion of the form. AN-2 site, elevation, QE, and angle "T" are determined to this target location. **Fire commands are not determined from this data!** (See Figures 13-33 and 13-34, Sample Records of Fire for SADARM)

b. Offset aimpoint for low level winds. The HCO places a target grid over the target location from step 1. He then applies the Direction of Wind from the Meteorological Message (Extracted from Line 3) and offsets the aimpoint by the distance determined by multiplying the Wind Speed (Extracted from Line 3) times the correction factor from Table "A", Column 5, expressed to the nearest 10 meters. *This is the offset aimpoint which is used to determine firing data for SADARM.*

c. Determine AN-2 graze burst data to the corrected aimpoint. The HCO announces chart range and deflection to the corrected aimpoint from step 2. These values are recorded in the Subsequent Fire Commands portion of the DA-4504. AN-2 graze burst data are determined to this offset aimpoint, to include Fuze Setting, Deflection to fire, and Quadrant Elevation (Site and angle "T" were determined in step (a.)).

d. Determine SADARM firing data from the ADD-W-0 or ADD-W-1. If data are being determined with the ADD-W-0, use paragraph (1.) below. If data are being determined with the ADD-W-1, then use paragraph (2.) below.

(1) ADD-W-0. First determine SADARM firing data from the ADD-W-0. Then the Height of Burst correction must be applied. Table 13-33 contains the HOB corrections by charge and AN-2 Quadrant Elevation. To extract values from the table, enter with Charge on the left, and with the AN-2 graze burst Quadrant Elevation on the top. If your Quadrant Elevation is less than or equal to the QE listed in Column 2, then use the up correction in Column 2. If it is greater than the value listed in column 3 and less than 800 mils, apply the up correction from column 3. If it is greater than 800 mils, apply the up correction from column 4. The extracted up correction is used to determine the change in Quadrant Elevation (from Table "A", Column 3) and change in Fuze Setting (from Table "B", Column 3) for the change in HOB. These values are then algebraically added to the ADD-W-0 data to determine the data to fire. The FT 155 ADD-W-0 use the following formulas:

DEFLECTION TO FIRE

AIMPT CHT DF+ADD-W-0 DF CORR+GFT DF CORR+AN-2 DFT=M898 DF

FUZE SETTING TO FIRE

AN-2 FS+ADD-W-0 FS CORRECTION+HOB FS CORRECTION=M898 FS

QUADRANT ELEVATION TO FIRE

AN-2 QE+ADD-W-0 QE CORRECTION+HOB QE CORRECTION=M898 QE

Table 13-33, FT 155 ADD-W-0 HOB Corrections

Column 1	Column 2	Column 3	Column 4
CHARGE	**AN-2 QE <=**	**AN-2 QE> and <800**	**AN-2 QE >800**
3G (M3A1)	QE<=498, U200	QE>498, U200	U250
4G (M3A1)	QE<=430, U100	QE>430, U150	U250
5G (M3A1)	QE<=366, U100	QE>366, U150	U250
3W (M4A2)	QE<=434, U100	QE>434, U200	U250
4W (M4A2)	QE<=388, U150	QE>388, U150	U250
5W (M4A2)	QE<=343, U150	QE>343, U150	U250
6W (M4A2)	QE<=305, U100	QE>305, U200	U300
7W (M4A2)	QE<=251, U100	QE>251, U200	U300
7R/8W (M119/A1/A2)	QE<=205, U100	QE>205, U200	U300
8S (M203/A1)	QE<=173, U100	QE>173, U200	U300

Table 13-34 contains the specific step action drill required to compute SADARM firing data using the ADD-W-0 method.

Table 13-34. SADARM employment procedures (FT 155 ADD-W-0)

STEP	ACTION
1	The call for fire is received
2	FDO issues Fire Order
3	The computer records the target information on the Record of Fire. (Note: All fire commands are announced as they are determined)
4	The HCO plots the target location on the firing chart and determines chart range, chart deflection, and angle "T" to the target.
5	The VCO determines and announces AN-2 site to the target location.
6	The Computer determines and announces the data for the offset aimpoint by extracting the Wind Direction and Wind Speed from line 3 of the meteorological message. The Wind Direction is announced in hundreds of mils. The aimpoint shift correction is determined by multiplying the windspeed times the value from column 5, Table "A" of the Firing Table Addendum. (Note, the entry argument for the addendum is the AN-2 data determined to the target location)
7	The HCO places a target grid over the target location and applies the Wind Direction announced by the Computer in step 5. The aimpoint shift correction is applied **into the wind**. (Note: the Wind Direction from the MET MSG is the direction the wind is blowing *from*.)
8	The HCO determines and announces chart range and chart deflection to the offset aimpoint. The target grid is then reoriented to the OT direction announced by the observer, as all corrections will be based on this aimpoint. Angle "T", however, is determined to the actual target location in step 4.
9	The computer determines AN-2 data to the corrected aimpoint.
10	The computer uses the data from step 9 to determine SADARM data.
11	The computer determines the FS HOB correction necessary by dividing the HOB correction from table 13-33 by 50. This value is then multiplied times the correction factor from Table "B", Column 3 of the ADD-W-0 addendum to determine the **HOB FS CORRECTION.**
12	The computer determines fuze setting to fire. The fuze setting to fire is determined with the following formula: **AN-2 FS+ADD-W-0 FS CORR+HOB FS CORR=M898 FS**
13	The computer determines the deflection to fire. The deflection to fire is determined with the following formula: **AIMPT CHT DF+ADD-W-0 DF CORR+GFT DF CORR+AN-2 DFT=M898 DF**
14	The computer determines the QE HOB correction necessary by dividing the HOB correction from table 13-33 by 50. This value is then multiplied times the correction factor from Table "A", Column 3 of the ADD-W-0 addendum to determine the **HOB QE CORRECTION.**
15	The computer determines the Quadrant Elevation to fire. The QE to fire is determined with the following formula: **AN-2 QE+ADD-W-0 QE CORR+HOB QE CORR =M898 QE**